The Status of the BEPC Linac Control System

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Introduction

The control system of the BEPC Linac has been being upgraded since 1993. Now an entirely new control system based on industrial PCs has replaced the old system based on manual operation. The system was put into fully routine operation since October 1995. It has been proved to the stable, reliable and efficient in the last two runs of BEPC. The e^- switch time and injection time are greatly reduced, since all magnets can be set in a few minutes automatically. Operator interfaces are friendly and easy to use. System failure very few and can be restored in a very short time. We are now networking all the computers together and doing some telecontrol experiments.

1 System architecture

The system consists of six industrial PCs. Each is responsible for the control and monitor of one or more BEPC Linac subsystems. They form the basic elements of a distributed control system. A/D cards, D/A cards and binary I/O cards are inserted into the expansion slots of industrial PCs . We use 12-bit ADC for data input and 12-bit DAC for output. The functions of each PC is described below.

1.1 The control of magnet current.

It controls all the power supplies for quadrupoles the steering coils and the focusing solenoids. These are the principal means to optimize the electro-optical paths. Good data of magnets are stored on the hard disk for further analysis and reference. The parameters for e+ and e- are stored in the memory, so the switch from one state to another can be done instantly. This avoids the poor repeatability caused by manual operating. The complexity of beam tuning decreases, and the beam tuning task is easier to perform.

1.2 Remote control of the modulators.

A new local system based on the PLC was installed and the communication between the control room and the modulators were accomplished. PLCs are used to replace the original relay control logic circuits of modulators. The new system is more flexible and reliable than the old one. The control PC inspects the PLCs through RS-232 port. The DC voltage, charging current, external failure signal, filament control filament current etc are sent to the control room. The DC voltage can be controlled remotely.

1.3 Target switching and phase adjustment.

The target switching can be performed by pushing a button on the screen. The microwave phase and magnet switching of the positron capture section are accomplished automatically. The phase adjustment of single RF source is accomplished on this computer.

1.4 Vacuum monitoring.

The status of the vacuum system is monitored by a PC. The section vacuum values, waveguide vacuum values, ion pump state and ion pump current values are gathered by the PC. When one of the section vacuum or waveguide vacuum values degrades to a certain value, there will be sound and screen color warning signals.

1.5 Others

The energy analysis, emittence measurement or the phase locking for RF phase control can all be performed by PCs. The control programs were primarily developed using Turbo C under DOS. We are now porting them to Windows platform using Microsoft Visual C++.

2 Networking

The networking of the BEPC Linac control system began in May 1996. Now the hardware and software configuration.have been completed. The telecontrol experiments have been done successfully.

2.1 Hardware configuration

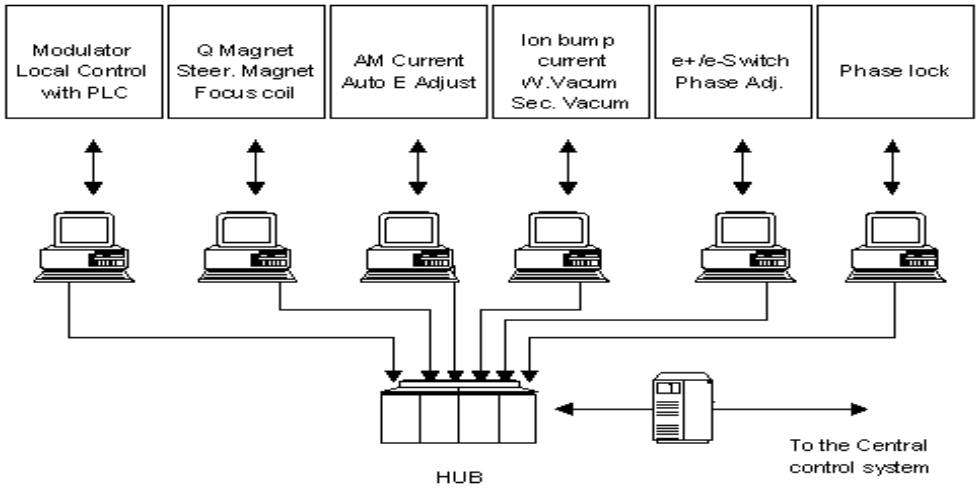
The control of accelerators requires high reliability. We selected the 10BASE-T net rather 10BASE-2. Compared to 10BASE-2, 10BASE-T has the following advantages: scalability, ease of upgrading to a 100Mbit network, good failure separation (the failure of one node won't affect other nodes). There are two Ethernet cards in the PC server. One is connected to the campus LAN of IHEP, through which communication between the central control system and the Linac local control system is done. The other is connected to the local control net. The HUB is stackable (3com 3c16670). The PC server is HP LH Plus. As for the Ethernet card , we selected Intel's EEPro 10M .

2.2 Software platform

Windows NT is used as the PC server's operating systems. It is more reliable than other PC based network operating system, such as Novell NetWare or Windows for workgroup. Visual C++ is selected as software development tool.

2.3 Communication protocol

TCP/IP has been developed since 1970. It is mature and is the international standard for interplatform communication in fact. During implementation, we have only



one IP address for our seven computers. So we use virtual IP addresses for the front end PCs.

2.4 Programming

Sockets is the communication interface for UNIX. For the Windows platform we have Windows Sockets, which is adapted to the message driven features of Windows applications. We use it as our network programming interface.

2.5 Experiments and results

Experiments have been done to telecontrol the RF phase adjust system. The program was developed using the client/server model. The server program runs on the industrial PCs. It was developed as a program external to the control program. When messages are sent from client program on the PC server, the server program will send a message to the control program. The same messages are generated from the control program's operator interface. The experiments were successful and all programs work together smoothly.

3 Conclusions

The upgrade of the BEPC Linac control system has been performed in a step by step manner. First, we built separated control systems to control separated BEPC Linac subsytems. Then we networked them together. Every component of the control system is fully tested before it is put into routine operation. Through three years of hard work by our control group, the whole system is a success.